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SYSTEM AND METHOD OF UPDATING  
RADIO NETWORK DATA

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BACKGROUND OF THE INVENTION

Technical Field of the Invention

[0001] This invention relates to telecommunication  
systems and, more particularly, to a system and method of  
updating radio network data in Internet Protocol (IP)  
Base Stations.

Description of Related Art

[0002] When system updates are performed in a radio  
telecommunications network, they often require that  
individual devices in the network's Base Stations (BSs)  
be updated to transmit new information over the air  
interface to mobile stations (MSs) operating in the  
service area of the network. Radio network data is sent  
from Mobile Switching Centers (MSCs) in the network to

the BSs where the data is used to update a variety of BS devices performing different functions. For example, data may be sent to update Digital Control Channel (DCCH) devices and Digital Traffic Channel (DTC) devices. The

5 term "devices" generally refers to the software that controls hardware devices such as transceivers, signal strength receivers, location verification modules, and so on. "Updates" may refer to radio network data updates or software updates to provide new device functionality.

10 For example, a radio network data update may provide a channel number to a particular device. A software update may change the functionality of a device from a DTC device to a DCCH device in the event of a DCCH failure.

[0003] Some of the network data may be applicable at

15 the cell level, and thus are applicable to all of the devices of a particular type in only a single BS. At other times, the network data may be applicable at the exchange level, and thus are applicable to all of the devices of a particular type in all of the BSs in the

20 network. The current method of updating device data at the cell level or exchange level involves sending a separate message from the MSC to each device to be updated. Since each BS has multiple DCCHs and DTCs, many duplicate messages containing the same information are

25 sent to the BS devices. For example, whenever the power-down registration status in the network is changed, one

message is sent to each DCCH in the network. There may be up to 8 DCCHs per BS, and it is not unusual to have approximately 400 BSs in a typical network. Thus, a total of 3200 messages are required for the update.

5     **[0004]**     The existing method obviously consumes a lot of processor time to send the messages, and consumes much of the signaling capacity between the MSCs and the BSs. It would be advantageous to have a system and method of updating radio network data that reduces the number of  
10    messages required, thereby reducing the processor load and signaling load on the network. The present invention provides such a system and method.

#### **SUMMARY OF THE INVENTION**

15    **[0005]**     In one aspect, the present invention is a method of updating radio network data in a plurality of devices deployed in a Base Station (BS) in a radio telecommunications network. The method includes the steps of interfacing the BS with a Mobile Switching  
20    Center (MSC) through an Internet Protocol (IP) packet data network, assigning the BS an IP address, sending device update data from the MSC to the BS in an IP message, and simultaneously updating the plurality of devices by the BS. In one embodiment, the BS joins a  
25    multicast group, and the device update data is sent in an IP multicast message. In another embodiment, the BS

monitors predefined User Datagram Protocol (UDP) ports for particular types of device update data, and the device update data is sent in an IP broadcast message.

5 [0006] In another aspect, the method of the present invention includes the steps of interfacing the BS with an MSC through an IP packet data network, assigning each of the plurality of devices an IP address, and sending device update data from the MSC to each of the plurality of devices in an IP message. In one embodiment, the IP message is an IP multicast message, and in another embodiment, the IP message is an IP broadcast message.

10 [0007] In another aspect, the present invention is a system in a radio telecommunications network for updating radio network data in a plurality of devices deployed in a BS in the network. The system comprises an IP packet data network for interfacing the BS with an MSC, an IP message transmitter in the MSC for sending device update data from the MSC to the BS in an IP message, and means within the BS for simultaneously updating the plurality of devices. In one embodiment, the IP message transmitter sends the device update data in an IP multicast message. In another embodiment, the IP message transmitter sends the device update data in an IP broadcast message.

20 [0008] In yet another aspect, the present invention is an IP Base Station in a radio telecommunications network.

The BS comprises a plurality of radio network devices, a signaling mechanism for receiving IP messages containing device update data from an MSC through an IP packet data network, and means within the BS for simultaneously  
5 updating the plurality of devices with the device update data. In one embodiment, the signaling mechanism receives IP multicast messages that contain device update data. In another embodiment, the signaling mechanism includes at least one UDP port for monitoring IP  
10 broadcast messages containing device update data.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The invention will be better understood and its numerous objects and advantages will become more apparent  
15 to those skilled in the art by reference to the following drawings, in conjunction with the accompanying specification, in which:

[0010] FIG. 1 is a simplified block diagram of a first embodiment of the system of the present invention;

20 [0011] FIG. 2 is a flow chart illustrating the steps of a first embodiment of the method of the present invention;

[0012] FIG. 3 is a simplified block diagram of a second embodiment of the system of the present invention;  
25 and

[0013] FIG. 4 is a flow chart illustrating the steps of a second embodiment of the method of the present invention.

5 **DETAILED DESCRIPTION OF EMBODIMENTS**

10 [0014] The present invention builds upon the premise that information at the cell level or exchange level does not have to be sent to the devices one at a time. For example, the fact that a new service is provided should apply to all of the DCCHs in a cell, and probably to all of the DCCHs in the network since all of the control channels need to broadcast the new service information. The present invention provides a fast method to distribute radio network data from the MSC to IP-based  
15 base stations using minimal signaling.

20 [0015] In networks that communicate between nodes utilizing the Internet Protocol (IP), message data is divided into a plurality of data packets, each having an identifying header that includes a source and destination address for the packet. The packets are then transmitted from the source to the destination through a plurality of routers in a connectionless packet-switched network. Additionally, the packets may be addressed to a plurality of destinations, and the packets are accordingly routed  
25 to each of the destinations.

[0016] In the present invention, the MSCs and BSs in the network are connected through a packet data network, and in a first embodiment, an IP multicast message is used to update radio network data in IP-based BSs.

5 Multicast is a datagram network protocol that enables an application to place a single packet on a network and have that packet transported to multiple recipients. With multicast, the packet is sent to a multicast group, which is simply an IP address that falls into IP class D (224.0.0.0 through 239.255.255.255). Recipients express an interest in receiving packets addressed to a particular multicast group. When sending a packet to the multicast group, a client inserts a packet into the network with the appropriate target address. The packet is then picked up by any host that is interested in that group.

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SUPA<sup>2</sup> [0017] In terms of the present invention, each BS and each base station device can be considered a host (it has an IP address). In IPv4, an IP address currently comprises 4 bytes (32 bits) in the format byte1.byte2.byte3.byte4. Each BS is associated with a unique network identifier such as its Base Station Identification (BSID) which, in the preferred embodiment, is based on the last 12 bits of its IP address: 4 bits of byte3 and all 8 bits of byte4. For instance, if the IP address of a BS is 139.12.2.4, the BSID is 2.4

(h'204). This example provides a range of BSIDs from 1 to 5095. This way of identifying the BS also applies to newer versions of IP such as IPv6, which allows for IP addresses of 128 bits.

5 [0018] Each base station device is associated with a device data type. Although there are several types of devices in the BS, the description herein is focused on two exemplary device data types: DCCH device data and DTC device data. In the exemplary multicast IP addresses constructed herein, 1 indicates DCCH device data, and 2 indicates DTC device data.

10 [0019] For cell-level updates, the multicast IP addresses are constructed based on the multicast group, device data type, and the BSID. The basic format of the cell-level multicast IP address is shown as:

239.device data type.BSID

Obviously, the MSC must maintain a database of BSIDs for all of the BSs in order to construct proper multicast IP addresses. For exchange-level updates, the multicast IP address is constructed based on the device data type, and utilizes an unassigned BSID such as 0.0. Thus, the basic format of the exchange-level multicast IP address is shown as:

239.device data type.0.0

25 BSID 0.0 is reserved for exchange-level updates, i.e. no base station in the network is assigned an IP address



ending with 0.0. The BSs may also be divided into other groupings that are to receive particular types of updates. For example, an update may be applicable to all of the BSs in a particular Location Area. In this case,  
5 after being informed about their Location Area, the BSs also join a multicast group comprising:

239.device data type.255.location area ID  
in which the third byte (255) indicates Location Area updates.

10 [0020] Some data is directed to individual devices, such as channel number or specific configuration data. That data should be directed to devices one at a time. This data can be sent to the base station multicast address, indicating within the message that it is for a  
15 particular device. The BS then updates the particular device. Alternatively, each device may be assigned its own IP address, and the message is sent directly to the device. The first option is preferred since there is less configuration required.

20 [0021] If each device in a BS is assigned its own IP address, then each device joins the multicast group corresponding to its device data type. For example, in a BS having a BSID of 23.45, each DCCH joins multicast group 239.1.23.45 for cell-level updates, and joins  
25 multicast group 239.1.0.0 for exchange-level updates. Likewise, each DTC in the same BS joins multicast group

239.2.23.45 for cell-level updates, and joins multicast group 239.2.0.0 for exchange-level updates.

[0022] When updating radio network data at the cell level, the MSC sends one message to the multicast group comprising 239.device data type.BSID for each device type. When updating radio network data at the exchange level, the MSC sends one message to the multicast address 239.device data type.0.0 for each device type. In both cases, the devices that joined the relevant multicast group receive the message. When the message is received, the BS may determine whether to immediately use the data or store it for use at a later designated time. At the designated time, the BS updates the appropriate devices indicated by the device data type in the message. For example, all of the DCCHs may be updated in the BS. The BS can then transmit related update information to the MSs operating in its cell. Using the present invention, the number of messages required to update a parameter at the exchange level is reduced from a typical 3,000 messages in existing networks to one message sent to the multicast group IP address. Thus, to update all of the DCCHs in the network, only one multicast messages must be sent by the MSC.

[0023] FIG. 1 is a simplified block diagram of the first embodiment of the system of the present invention. A Network Configuration Manager (NCM) 11 provides an MSC

12 with BSIDs 13 for each of the BSs in the network. The MSC stores the BSIDs in a BSID database 14. The NCM also provides updates for device data 15 to the MSC. These updates are received in a function that can be called a  
5 Device Data Update Receiver 16. For cell-level updates, a Multicast IP Address Generator 17 in the MSC uses a BSID from the database and a device data type from the device update data to generate a multicast IP address. An IP Multicast Message Transmitter 18 then places the  
10 device data in an IP message and sends it over a Packet Data Network (PDN) 19 to the multicast IP address. As noted above, exchange-level updates utilize a BSID of 0.0 in the multicast IP address.

[0024] A BS 21 that has joined the multicast group  
15 designated in the multicast IP address receives the message in an IP Multicast Message Receiver 22. The BS determines whether the update is to be performed immediately, or at a designated time. The BS also determines whether the update is applicable to a single  
20 device or all of the devices of the indicated type. If the update is applicable to all of the devices of the indicated type, a Simultaneous Device-Update Mechanism 23 then updates all of the devices at once. An MS Update Mechanism 24 then sends related update information to the  
25 MSs operating in the BS's cell.

[0025] FIG. 2 is a flow chart illustrating the steps of a first embodiment of the method of the present invention. At step 31, the NCM 11 sends updated device data to the MSC 12. At 32, the MSC determines whether the updated data is applicable at the cell level or the exchange level. For cell-level updates, the method moves to step 33 where a BSID is obtained for the designated cell from the database 14. For exchange-level updates, the method moves to step 34 where a BSID of 0.0 is utilized. At step 35, the MSC determines the device data type, and then uses the BSID and device data type to generate a multicast IP address at 36.

[0026] At step 37, the MSC sends the updated device data in an IP multicast message through the PDN 19 to the multicast IP address. At 38, the BS 21 receives the IP multicast message, and at 39, determines whether the update is to be performed immediately, or at a specified time. If a time is specified, the method moves to step 41 where the BS waits for the specified time before moving to step 42. If the update is to be performed immediately, the method moves to step 42 where it is determined whether the update is applicable to a single device or all of the devices of the indicated type. If the update is applicable to a single device, the method moves to step 43 where the BS updates the device data for the identified device. If the update is applicable to

all of the devices of the indicated type, the method moves to step 44 where the BS then updates all of the devices at once. At step 45, the BS then updates the MSs operating in the BS's cell.

5     [0027]     In a second embodiment of the present invention, an IP broadcast message is used to update radio network data in IP-based BSs. Broadcast-based networks (such as Ethernet) have a broadcast address, which is an IP address that is received by all the hosts  
10     on the network. A packet can be transmitted to this address, and it will be picked up by every host on the network. In essence, an IP broadcast message places a single packet on the network, and all interested hosts pick it up.

15     [0028]     To the IP packet data network, message traffic is sent, either directly or via routers or otherwise, from the MSC to a plurality of Network Interfaces (NIs), which, as their name implies, act to interface layers on the network. Each NI is associated with a BS. Each BS  
20     contains a plurality of User Datagram Protocol (UDP) ports. These ports are said to "listen" for message traffic directed to that particular port. The BS must choose a UDP port number on which to operate. Port numbers range from 1 to 65535, with ports 1 to 1023 being  
25     reserved for system applications. Once a given BS identifies message traffic as being directed to it, the

BS takes appropriate action in response to the message received. This may include transmitting control messages to the MSs within the BS's coverage cell.

[0029] In the second embodiment, each BS is again assigned a BSID in the range of 1 to 5095. The base stations monitor broadcast messages on ports associated with each type of update. For example, the following ports may be associated with the following types of updates:

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<u>PORTS</u>	<u>TYPE OF UPDATE:</u>
10000	Exchange-level update for DCCH
10000 + BSID	Cell-level update for DCCH
20000	Exchange-level update for DTC
20000 + BSID	Cell-level update for DTC

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For example, a DCCH device in a BS with a BSID of 765 listens to port 10000 for exchange-level updates, and listens to port 10765 for cell-level updates. A DTC device in the same BS listens to port 20000 for exchange-level updates, and listens to port 20765 for cell-level updates.

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[0030] When updating radio network data at the exchange level, the MSC sends one message to the broadcast IP address of the network directed to port 10000 for DCCH data, and directed to port 20000 for DTC

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data. When updating radio network data at the cell level, the MSC sends one message to the broadcast IP address of the network directed to port 10000+BSID for DCCH data, and directed to port 20000+BSID for DTC data.

5 When the message is received, the BS updates the appropriate devices indicated by the device data type in the message.

[0031] The BSs in the network must be configured with the ports to monitor. Two ports are required for each device type, one for exchange-level updates and one for cell-level updates. Thus, if the method is limited to updating DCCHs and DTCs, each BS must be configured with four ports (2 for exchange-level updates and 2 for cell-level updates). The number of ports will be greater if  
10 the method is applied to additional device types.  
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[0032] FIG. 3 is a simplified block diagram of the second embodiment of the system of the present invention. Like the first embodiment, the NCM 11 provides the MSC 12 with BSIDs 13 for each of the BSs in the network. The MSC may utilize a lookup table 51 to convert the BSIDs to a number that is added to the base UDP port number for cell-level updates. The NCM also provides updates for device data 15 to the MSC. These updates are received in the Device Data Update Receiver 16. An IP Broadcast  
20 Message Transmitter 52 places the device data in an IP message and sends it over the PDN 19 to the broadcast IP  
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address of the network. For updates at the exchange level, the broadcast message is directed to a port such as port 10000 for DCCH data, and directed to a port such as port 20000 for DTC data. When updating radio network data at the cell level, the MSC sends one message to the broadcast IP address of the network directed to port 10000+BSID for DCCH data, and directed to port 20000+BSID for DTC data.

[0033] The BS 21 receives the IP broadcast message through the designated port and an IP Broadcast Message Receiver 53. The BS determines whether the update is to be performed immediately, or at a designated time. The BS also determines whether the update is applicable to a single device or all of the devices of the indicated type. If the update is applicable to all of the devices of the indicated type, the Simultaneous Device-Update Mechanism 23 then updates all of the devices at once. The MS Update Mechanism 24 then sends related update information to the MSs operating in the BS's cell.

[0034] FIG. 4 is a flow chart illustrating the steps of the second embodiment of the method of the present invention. At step 61, the NCM 11 sends updated device data to the MSC 12. At 62, the MSC determines which type of devices are being updated. For example, the system may be designed to update either DCCHs or DTCs. Therefore, the MSC determines whether the update is for



DCCHs or DTC. If the update is for DCCHs, the method moves to step 63 where the MSC may use UDP port 10000 as a base number for DCCH updates. If the update is for DTCs, the method moves to step 64 where the MSC may use  
5 UDP port 20000 as a base number for DTC updates.

[0035] If the update is a DCCH update, the method moves from step 63 to step 65 where the MSC determines whether the updated data is applicable at the cell level or the exchange level. For cell-level updates, the  
10 method moves to step 66 where the BSID for the target cell (converted to a UDP port number) is added to the base number of 10000 to obtain the UDP port number for the IP broadcast message. For exchange-level updates, the method moves from step 65 to step 67 where the base  
15 number of 10000 is utilized as the UDP port number for the IP broadcast message.

[0036] If the update is a DTC update, the method moves from step 64 to step 68 where the MSC determines whether the updated data is applicable at the cell level or the  
20 exchange level. For cell-level updates, the method moves to step 69 where the BSID for the target cell (converted to a UDP port number) is added to the base number of 20000 to obtain the UDP port number for the IP broadcast message. For exchange-level updates, the  
25 method moves from step 68 to step 71 where the base

number of 20000 is utilized as the UDP port number for the IP broadcast message.

5       [0037]       At step 72, the MSC sends the updated device data in an IP broadcast message to the broadcast IP address of the network. The message is directed to the designated UDP port number as determined for the device data type and whether the update is a cell-level update or an exchange-level update. As shown at step 73, the BSs in the network monitor broadcast messages on the UDP  
10       ports associated with each type of update. When the IP broadcast message is received at step 74, the BS updates the appropriate devices indicated by the device data type in the message.

15       [0038]       At step 75, the BS determines whether the update is to be performed immediately, or at a specified time. If a time is specified, the method moves to step 76 where the BS waits for the specified time before moving to step 77. If the update is to be performed immediately, the method moves to step 77 where it is  
20       determined whether the update is applicable to a single device or all of the devices of the indicated type. If the update is applicable to a single device, the method moves to step 78 where the BS updates the device data for the identified device. If the update is applicable to  
25       all of the devices of the indicated type, the method moves to step 79 where the BS then updates all of the

